92-06209/

Ontario

ORDER NO. 92-015

JANUARY 1992

AGDEX 420/50

Factsheet

BEEF COW-CALF NUTRITION

Tom Hamilton, Beef Cattle Specialist, Animal Industry Branch

INTRODUCTION

Nutrition is one of the key components in cow-calf production. Feed is usually the single largest expense in a beef enterprise. Efficient management of feed resources is necessary for profitability. Understanding the requirements of the breeding herd and growing calves will allow the herd manager to properly allocate and supplement home-grown feeds.

NUTRIENTS

Nutrients required by beef cattle include energy, protein, salt, minerals, vitamins and water. A discussion of these nutrients and their digestion is contained in OMAF Factsheet, *Basic Beef Nutrition*, Agdex 420/10. In most beef cow herds, energy and protein are supplied by forages such as hay, haylage, corn silage and pasture. In some situations, corn stover and other crop residues or by-product feeds are used as low-cost components of the feeding program. In many instances, supplementary minerals are required to balance the ration. Vitamin supplementation may be required, depending on the type and quality of feeds in the ration.

REQUIREMENTS

The basic source of information on nutrient requirements is the National Research Council (NRC) publication *Nutrient Requirements of Beef Cattle*. These are established by a committee of scientists which reviews and summarizes the scientific literature on the topic. Periodically, the NRC committee reviews new studies and updates the requirements.

Each class of cattle has a specific requirement for each nutrient. A "class" within the cow herd is defined by weight, stage of pregnancy, condition score and milking ability. Some examples of nutrient requirements for beef cows are given in Table 1.

Table 1. Daily Requirement For Some Major Nutrients For a 1200 lb Beef Cow at Three Stages of the Production Cycle*

(a) Requirements As a % of Dry Matter in the Diet

Nutrient	Dry, Middle Third of Gestation	Dry, Last Third of Gestation	Lactating, 20 lbs/day
TDN	48.8	52.9	63.7
CP	6.9	7.8	11.5
Ca	.19	.26	.36
P	.19	.21	.26

(b) Requirements As Lbs of Nutrient Per Day

Nutrient	Dry, Middle Third of Gestation	Dry, Last Third of Gestation	Lactating, 20 lbs/day
DM	20.8	22.3	23.8
TDN	10.1	11.8	15.2
CP	1.4	1.7	2.7
Ca	.04	.06	.09
P	.04	.05	.06

** NRC 1984.*

Ration balancing is the practice of formulating a diet which meets the animal's requirements for all nutrients. It requires that the nutrient content of feeds available be known accurately, and that the animal class is precisely described. Nutrient content of forages varies widely, so laboratory analysis of forages to determine nutrient content is a necessity. Analysis of grains is also desirable. For more information on feed analysis, see OMAF Factsheet, *Feed Sampling and Analysis*, Agdex 400/60. OMAF provides a timely, user friendly, free, computerized Beef Ration Formulation service. Contact your Beef Cattle Specialist or your local OMAF office for more information.

MINERALS

Minerals required by beef cattle include the macro minerals calcium, phosphorous, magnesium, sodium, sulphur and potassium, and the micro or trace minerals selenium, zinc, cobalt, copper and iodine. The requirement for one mineral may be influenced by the level of other nutrients in the ration, particularly other minerals.

Calcium

Calcium is the most abundant mineral in the body. It is required for bone formation, development of teeth, milk production and muscle movement. Deficiency of calcium in young animals results in rickets. The bones are weak and lack density. Symptoms include an arched back, swollen joints and bowed legs. In older animals, calcium deficiency results in osteomalacia, the demineralization of the bones; this causes bones to become brittle and weak. Vitamin D is required for the metabolism of calcium. Lack of vitamin D results in the same symptoms as a lack of calcium.

The absorption and metabolism of calcium is closely related to that of phosphorous. As a result, the ratio of calcium to phosphorous in the ration is of concern, as well as the actual amount of each mineral. For growing cattle, a cal:phos ratio of between 1.5:1 and 5:1 is acceptable. For the breeding herd, the ratio should be between 1.5:1 and 3.5:1. An inverted cal:phos ratio (more phosphorous than calcium) results in markedly reduced performance and feed efficiency and the formation of "stones" in the urinary tract.

Legume forages contain high levels of calcium. Grass forages and oilseed meals contain moderate levels of calcium, while grains and corn silage have a low calcium content.

Phosphorous

Phosphorous is a major component of bone, is involved in energy metabolism, and plays an important role in blood acid-base balance. Phosphorous deficiency results in decreased growth rate, inefficient feed utilization, low conception rates, joint stiffness and fragile bones. Affected animals may eat soil,

wood or hair. The association of phosphorous with calcium is discussed above.

Most forages have a relatively low phosphorous content. Grains contain a moderate amount of phosphorous, while oilseed meals are high in phosphorous. Phosphorous deficiency (or a high cal:phos ratio) is one of the most common mineral-related problems in cow-calf nutrition. It is often involved in cases of poor reproductive performance.

Magnesium

Magnesium is required for skeletal development, nerve impulse transmission and enzyme activity. Cattle deficient in magnesium exhibit reduced feed intake and feed efficiency, and poor bone and teeth development. In severe cases, cattle become uncoordinated, display muscle tremors and eventually convulse. Death usually occurs in these severe cases. Acute magnesium deficiency may occur on lush, predominately grass pastures in spring, hence the common name "grass tetany." In this situation, the level of magnesium in the feed is low, while calcium and potassium (which may interfere with magnesium absorption) levels are high.

Sodium and Chlorine

Sodium and chlorine are usually considered together, since the principal source of supplementation is sodium chloride (common salt). Sodium functions in maintaining body fluid balance and acid-base balance. Chlorine is essential in respiration and the regulation of blood acidity. Sodium deficiency results in a craving for salt as evidenced through constant licking. Weakness, poor performance and rough hair coat are symptoms of salt deficiency. Many forages are low in sodium content. Grains contain very low levels of sodium. Cattle should always have access to blue (cobalt-iodized) salt if it is not incorporated into the ration at the required level. Trace mineralized (red) salt may be required if adequate trace minerals are not present in the ration. Trace mineral supplementation does not reduce the need for supplementation with macro minerals (e.g., calcium, phosphorous). When sufficient salt is consumed to meet the requirement for sodium, the need for chlorine will also be met.

Selenium

Selenium is an essential component of an enzyme that protects membranes from oxidation. The requirement for selenium is modified by the amount of vitamin E in the diet. The need for selenium is reduced when vitamin E is present at a moderate level.

Selenium/vitamin E deficiency results in white muscle disease. This is a degeneration of skeletal and heart muscle tissue characterized by white areas within the muscle. It most commonly affects young calves, which may exhibit lameness or paralysis. They may also appear normal until dying of heart failure, often after being stressed. Older animals may also be affected by white muscle disease.

Soils in most of Ontario are low in selenium, resulting in low levels of selenium in the plants grown in these soils. Selenium may be added to diets as a component of commercial mineral mixes, commercial protein supplements, salt with added selenium, or given by injection in a solution with vitamin E. Cows should receive supplementary selenium in some form. Pregnant cows will pass some vitamin E/selenium on to their calves. Newborn calves should be injected with vitamin E/selenium unless the selenium status of the cows is known to be good. Where previous problems have occurred, calves should receive a second injection 3 weeks after the first.

The toxic level of selenium in the diet (2 ppm) is only 10 times greater than the recommended level (0.2 ppm). Care must be taken that selenium is not over supplemented in the ration. It is generally recommended that only one source of supplemental selenium be included in the diet.

VITAMINS

Vitamins are biological compounds which are active in very small amounts. Cattle have physiological requirements for most vitamins required by other mammals. However, rumen microbes manufacture a wide range of vitamins, including vitamin K and the B vitamin group. Dietary requirements are usually restricted to vitamins A, D, and E. Vitamin requirements are given in terms of International Units (IU's) of activity.

Vitamin A

Vitamin A is essential for normal growth, reproduction and vision. Requirements for Vitamin A range from 1000 IU/lb of dry feed for growing cattle to 1800 IU/lb of dry feed for lactating cows and breeding bulls. High quality fresh and dry cured forages are excellent sources of Vitamin A. The vitamin A level in hay declines over time. The ensiling process renders much of the vitamin A unavailable. Grains usually have a low vitamin A content. The liver can store 2-4 months worth of vitamin A when cattle have been on a vitamin A rich diet.

Vitamin A deficiency may occur in cattle consuming over-mature pasture, high concentrate diets, ensiled feeds or hay which is more than one year old. Signs of vitamin A deficiency include reduced feed intake, diarrhea, joint edema, low conception rates, night blindness and susceptibility to respiratory and other infections. Vitamin A can be added to the diet through a special vitamin premix, or given by injection (supplies requirement for 3-4 months). Commercial protein supplements and mineral mixes usually contain added vitamin A. The level of vitamin A supplied in these products should be evaluated with respect to that required in the ration.

Vitamin D

Vitamin D is required for calcium and phosphorous absorption and normal mineralization of bone. The requirement for vitamin D is 125 IU/lb of dry diet. Cattle can manufacture vitamin D when exposed to direct sunlight. Fresh forages and well preserved dry hay are good sources of vitamin D. Deficiencies in adult animals are usually limited to cattle confined to barns and fed grain and silage rations. Calves suffering from vitamin D deficiency suffer from rickets (weak, bent long bones), swollen joints and slow growth.

Commercial protein supplements, vitamin premixes, and mineral mixes usually contain added vitamin D. The level of vitamin D found in some mineral mixes designed for free choice consumption is too low to provide a significant amount of vitamin. A liquid form of vitamins A and D is available for injection. One injection will last for 3-4 months.

Vitamin E

The requirement for Vitamin E is not precisely known. Vitamin E requirement of young calves is estimated to be between 10 and 30 IU/lb of dry diet. The relationship between vitamin E, selenium and white muscle disease is discussed above. Some supplements containing vitamins (particularly liquid injectables) contain extremely small amounts of Vitamin E. In these products, the Vitamin E is added to prevent oxidization of Vitamins A and D, and is not significant on a nutritional basis.

NUTRITION DURING THE BEEF COW PRODUCTION CYCLE

Nutrient requirements of cows change with the stage of the production cycle. Requirements are moderate during the last third of pregnancy, highest during lactation and lowest when

the cow is dry and in the middle of pregnancy. Energy requirements are also affected by environmental temperature, wind speed, and the amount of insulation (fat and hair) on the cow. In most herds, cows calve in late winter/early spring (February, March, April). The cows and calves go to pasture for the summer, with calves being weaned in fall (October, November). Cows are dry and pregnant over the winter.

Feeding Groups

Grouping animals of similar requirements (e.g., size, age, body condition) allows for more precise feeding management. Grouping also eliminates competition between animals which have very different body sizes. It is most easily accomplished during the winter feeding period when animals are being fed stored feed in a confinement or semi-confinement situation. Replacement heifers must be fed separately from the rest of the herd. This makes it possible to feed them the grain they require to achieve a growth rate of 1.25-1.75 lbs/day, depending on frame size. They should also be fed the highest quality forage available. For more information on replacement heifers, see OMAF Factsheet, *Feeding and Managing Replacement Heifers*, Agdex 420/01.

Middle Third of Pregnancy

The cow is normally not milking during this period. The fetus is still quite small and imposes a relatively small demand on the cow for nutrients (Figure1). During this period, free choice medium-quality hay with a minimum of 8% CP and 50% TDN will supply adequate protein and energy for a cow in average body condition. This is the most appropriate time of year to adjust body condition. Cows should go into winter with a condition score of 3 to 3.5. This will give them a good layer of insulative fat during the cold months and an energy reserve at calving. If cows are thin, good-quality hay and/or some grain supplementation will increase body condition. If cows are overly fat, limiting good quality hay or feeding low-quality hay will reduce body condition. For more information on body condition scoring, see OMAF Factsheet, *Body Condition Scoring of Beef Cows*, Agdex 424/20.

Last Third of Pregnancy

The last third of gestation is a critical period for the nutrition of the cow. The cow's requirements for energy and protein during the last third of pregnancy increase by 20% over those of the middle third. The fetus is in the period of most rapid growth (Figure1), approaching 1.0 lb/day. The growth rate slows markedly about 2 weeks before birth. A cow in average body condition will need free choice hay with a minimum of 10% CP and 54% TDN. Cows which are overly fat at calving (body condition score 4.0+) have an increased risk of calving difficulty. The birth canal may become narrowed due to the presence of fat deposits, and the cow may not have the ability to persist with strong contractions during delivery. The under-feeding of cows during late gestation will reduce the birth weight of the calf. However, this practice also produces weaker calves and cows and results in a decrease in calf survival.

Calving to Breeding

Requirements for all nutrients increase dramatically following calving. Milk production requires large amounts of energy, protein and calcium. Energy requirements for a high milking beef cow may increase by 50% over the requirement during the middle third of pregnancy, while the protein requirement doubles. Most cows will exhibit some weight loss during early lactation, even when on good quality feed. Feeding some grain may be necessary, depending on the quality of forage and milking ability of the cow. Young cows, particularly first calf heifers which are still growing, may need some grain.

In most cases, cows are put on pasture some time after calving. Early season pasture is usually an excellent source of protein, energy and calcium. The mineral mix fed on pasture should be designed to attempt to maintain an overall calcium:phosphorous ratio of 2:1 (acceptable range 1.5 to 3.5:1). For grass pastures and those containing up to 50% legume, a 1:1 mineral is appropriate. For high legume pastures, a high phosphorous, low calcium mineral (e.g., 0:20) should be fed. High phosphorous minerals are not usually very palatable. To encourage consumption, mix the mineral with an equal amount of salt, and remove other sources of salt.

The level of magnesium in lush pasture may be quite low. Lack of magnesium may cause grass tetany, also called grass staggers. Affected cows become uncoordinated, tremble and go

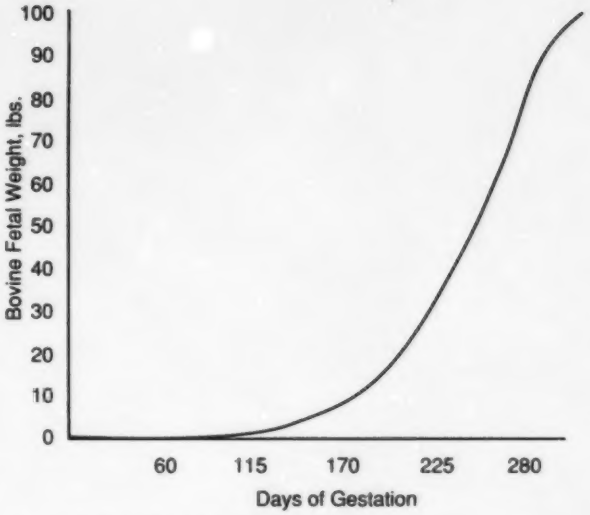

Figure 1. Growth of the bovine fetus

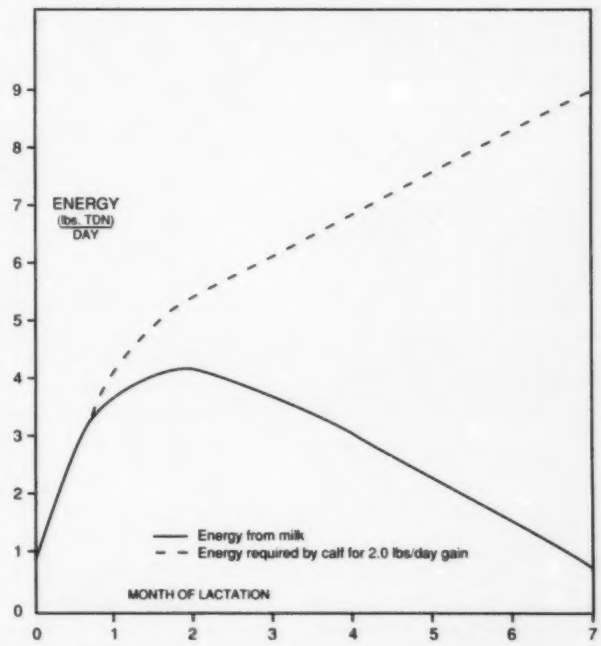

Figure 2. Relationship of Energy required by the growing calf and energy supplied in milk from cow with peak lactation of 24 lbs/day

down. They may die if not treated. To prevent grass tetany, the mineral mix fed should contain a minimum of 4% magnesium. In extreme cases, higher levels of magnesium supplementation may be required.

The period from calving to breeding is the most critical for reproductive efficiency. Pregnancy lasts an average of 285 days. To maintain a calving interval of 365 days, the cow must be rebred within 80 days after calving. The cow's physiological priorities at this time are: 1. maintain herself, 2. produce milk for her calf , and 3. return to estrus. Adequate nutrition is essential if the cow is to recover from the stress of calving, produce milk, and be in condition to return to estrus and be bred within 80 days after calving. Much better conception rates can be expected if cows have maintained or achieved a body condition score of at least 3 by breeding time. It is beneficial if cows are on a "rising plane of nutrition" and gaining weight at this time. Cows are usually on summer pasture at this time. Grasses and legumes at the immature, vegetative stage are high quality feed. The crude protein content may be as high as 25%, with a correspondingly high energy value of up to 70% TDN. They also have a very high content of vitamin A. Adequate phosphorous is critical for good reproductive performance. Most pastures are low in phosphorous, so feeding an appropriate mineral mix is important. For more information on beef cow reproduction see OMAF factsheet, *Breeding Season Management*, Agdex 420/10.

Breeding to Weaning (First Third of Pregnancy)

During this time the cow is lactating and pregnant. The fetus is very small and imposes little demand on the cow. The decision of when to wean calves may be made partly on the basis of the body condition of the cows. If the cows are in poor condition, early weaning will allow them to regain body fat reserves prior to winter. Body condition should be monitored during this period to ensure that cows do not become too thin. This may happen if pasture quantity and quality decreases. Providing creep feed to the calves will maintain calf growth and may reduce stress on the cows if pasture is in poor condition. For more information on creep feeding, see OMAF Factsheet, *Creep Feeding Beef Calves*, Agdex 420/50.

Controlled grazing management will help ensure that cows have access to high quality, vegetative forage throughout the pasture season. It will also boost production on a per acre basis. For more information on pasture management, see OMAF Publication 19, *Pasture Production*.

NUTRITION OF THE CALF

Rumen Development

The calf's rumen is non-functional at birth. The nutrition of the new born calf is essentially like that of a monogastric animal. Initially, the diet consists of the cow's milk, which contains 25% CP and 130% TDN. When the calf suckles, a reflex action causes a contraction in the rumen called the esophageal groove. This channels the milk directly into the abomasum (true stomach) where digestion starts. Development of a rumen microbe population begins as the calf ingests microbes from the environment (cow, soil, etc.). As the calf starts to consume solid feed such as pasture or grain, the rumen becomes a functioning digestive organ. The rate at which the rumen becomes functional is dependant on the amount of non-liquids consumed.

Colostrum

Consumption of colostrum (first milk) is essential in maintaining the health of the calf. Disease fighting antibodies are not passed across the placenta from cow to fetus. The antibodies must be transferred via the colostrum. Thin cows may not produce an adequate amount of high quality colostrum. It is essential that calves consume colostrum equal to a minimum of 5 % of their body weight (1.0 litre/45 lbs of body weight) as soon after calving as possible. The calf's ability to absorb antibodies from colostrum is high immediately following birth. Calves which have not nursed within 2 hours of birth should be assisted. After 6 hours, the ability of the calf to absorb antibodies declines. In addition to containing antibodies, colostrum is rich in vitamins and energy. Calves which have not received an adequate amount of good quality colostrum have a lack of immunity to disease. They are susceptible to many calfhood diseases, which may result in diarrhea, dehydration and death.

Vitamins

Calves which have not received an adequate amount of good quality colostrum may be deficient in vitamin A and/or D. This may result in blindness, in the case of vitamin A deficiency, or weakness or rickets in the case of vitamin D. This may also occur in calves when pregnant cows are fed a low quality diet, and have not transferred adequate amounts of vitamins to the fetus. Injecting newborn calves with a mixture of vitamin A and D is a good management practice. The commercial A-D preparations contain a very small amount of vitamin E to protect the A and D, however, the vitamin E content is not nutritionally significant. The importance of vitamin E and selenium in the prevention of white muscle disease is discussed in the section on minerals.

Milk Production and Calf Requirements

Milk production of the cow peaks about 2 months after calving. Nutrient requirements of the calf increase rapidly with increasing body weight. By the time the calf reaches 350 lbs (approximately 4 months of age), the milk supplied by a beef cow with a peak milk production of 24 lbs/day will provide less than half of the calf's energy requirement for a 2.0 lb/day gain (see Figure 2). The calf must consume significant amounts of good quality dry feed to maintain an acceptable rate of growth. The young calf needs feed with a minimum of 18% CP and TDN of 70-80%. This can be supplied by good quality forage in the vegetative state. Most pastures will not be maintained in this state after the middle of July unless some form of controlled grazing is practiced. If enough high quality feed is not available, growth of the calf will be restricted.

If pasture conditions are poor, or if calves are born in the fall, then a creep ration to which the cows do not have access should be provided. In these situations cows may also need some grain to maintain adequate body condition. This is normally done in the form of a grain mix, but it may also be in the form of creep grazing. For more information on creep rations, see OMAF Factsheet, *Creep Feeding Beef Calves*, Agdex 420/50.

SUMMARY

Efficient management of feed resources is necessary for the profitability of the beef cow-calf operation. Managers must understand the requirements of both the cow and the calf to ensure that nutrition is adequate. Feeds (especially forages) must be analyzed for nutrient content, and the results used to formulate appropriate rations. Proper nutrition and feeding management will help animals to achieve performance goals.

REFERENCES

NRC. 1984. *Nutrient Requirements of Beef Cattle* (6th Ed.). National Academy of Sciences, Washington, D.C.

Radostits, O.M., and S.D. Acres, 1983. *The Control of Acute Undifferentiated Diarrhea of Newborn Beef Calves*. In Veterinary Clinics of North America: Herd Health Management – Cow-calf and Feedlot. W.B. Saunders Co., Philadelphia.

10M
ISSN 0225-7882